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[54] **LIQUID-JETTING HEAD**

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[51] **Int. Cl.**[4] **G01D 15/18**
[52] **U.S. Cl.** ..... **346/140 R**
[58] **Field of Search** ..... 239/266, 303, 305, 536, 239/549, 561, 566; 346/140 PD

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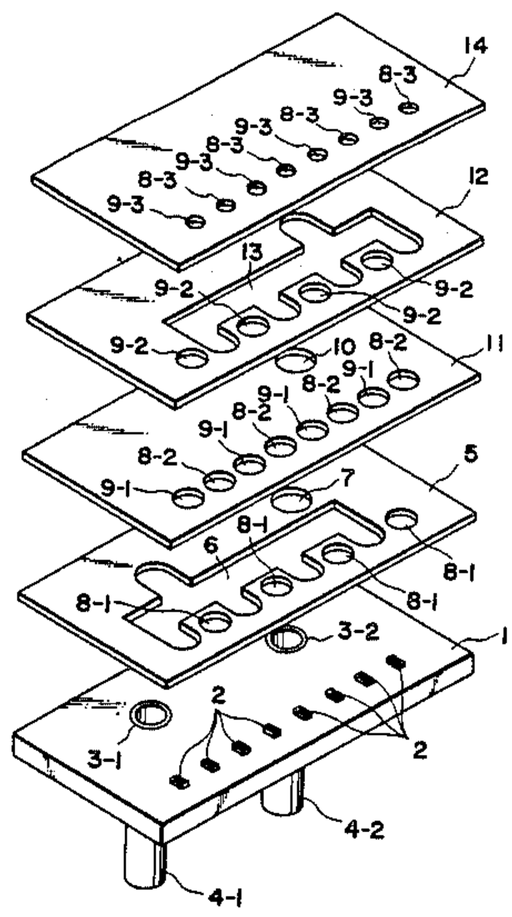
Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] **ABSTRACT**

A liquid-jetting head comprising a plurality of liquid-jetting-pressure-generating elements and a plurality of liquid-jetting orifices opposite to said elements through a liquid passage is characterized in that said passage is divided into at least two groups, and the adjacent elements of said elements are separately communicated with isolated respective liquid passages.

16 Claims, 14 Drawing Figures



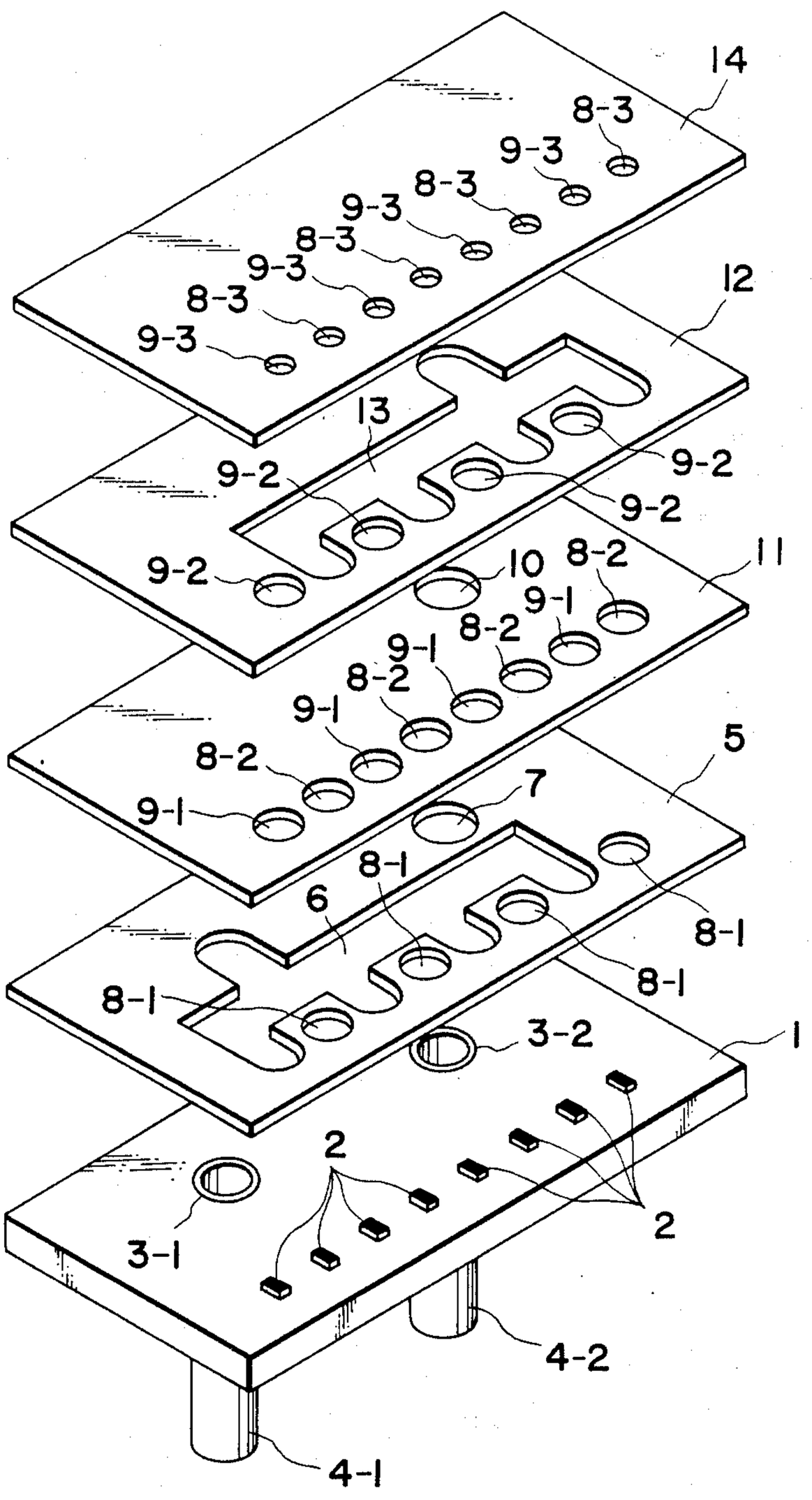

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FIG. 1

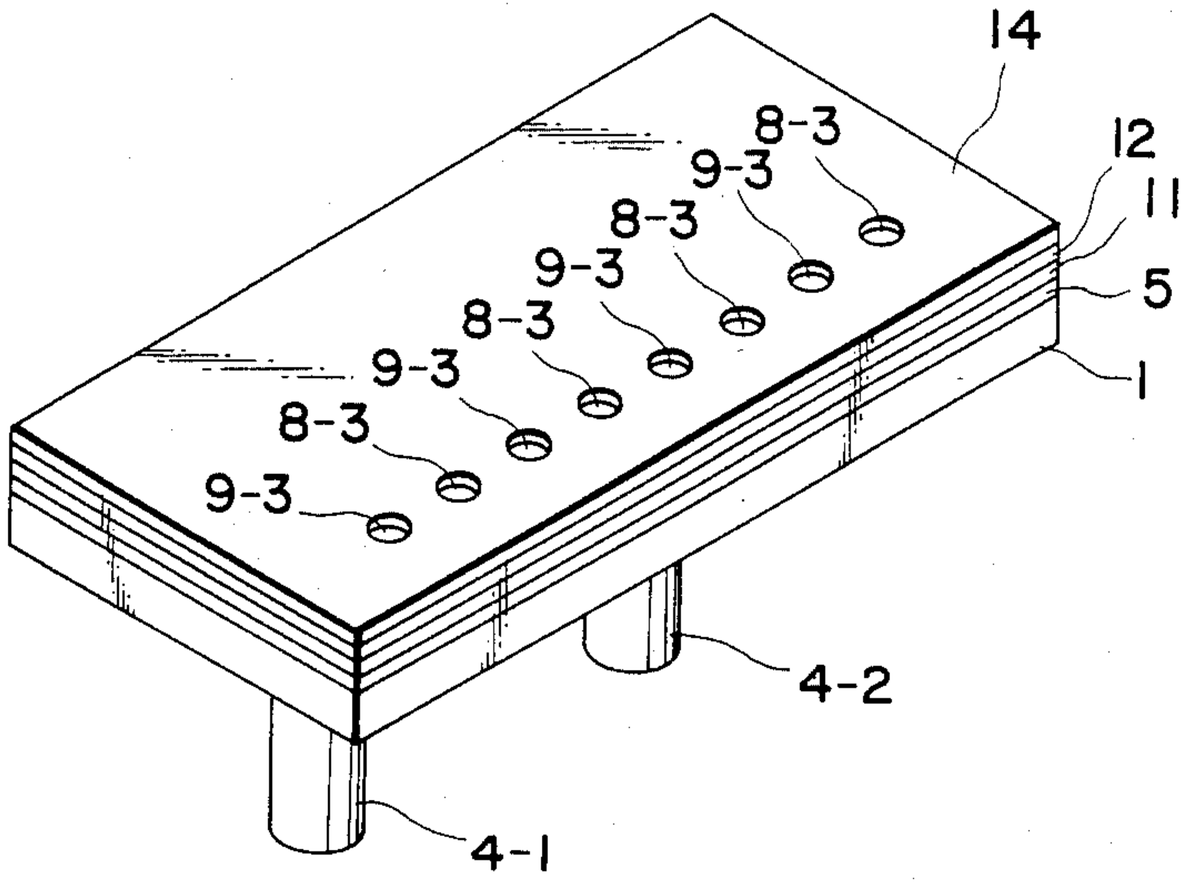
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FIG. 2

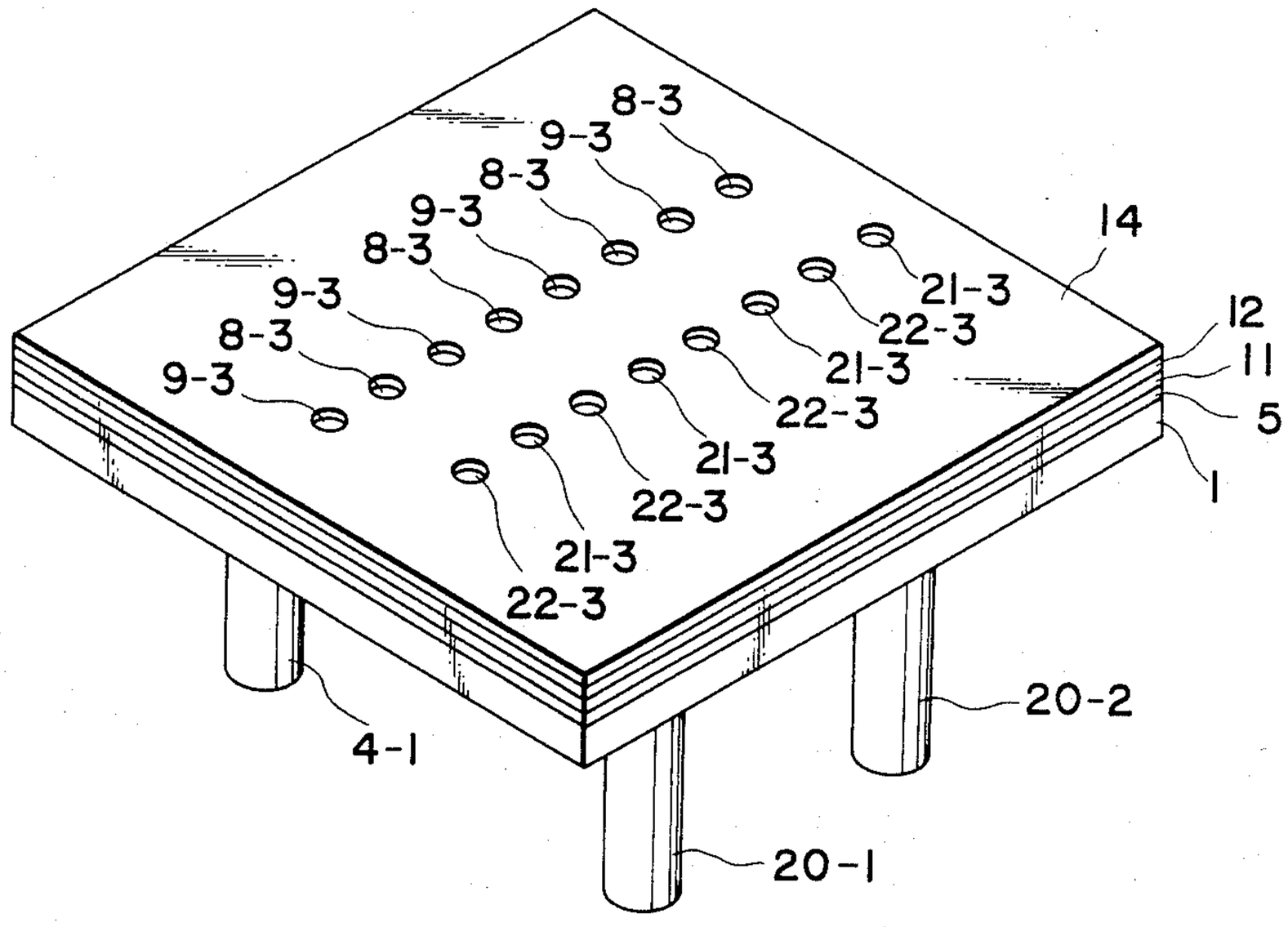
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FIG. 3

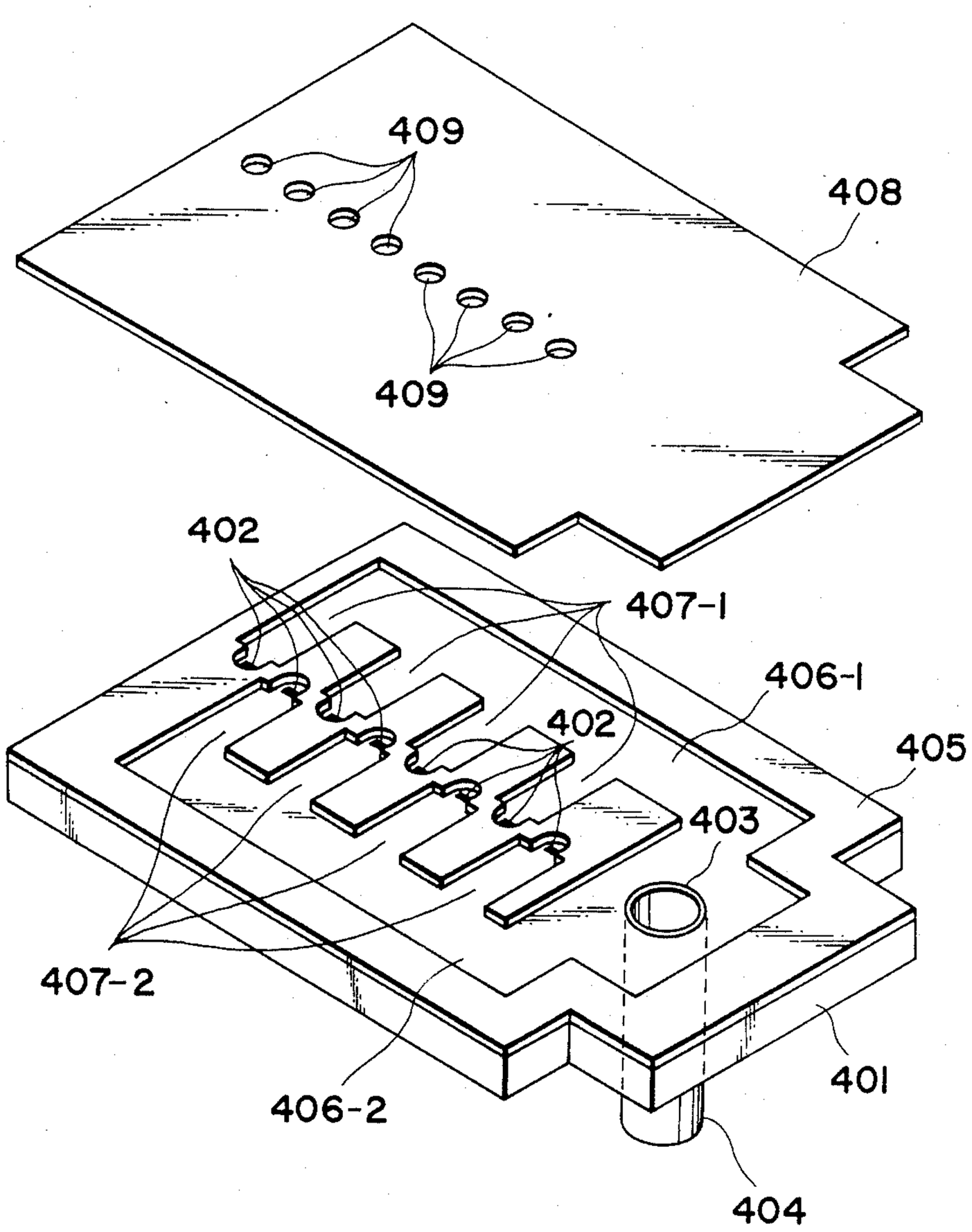

FIG. 4

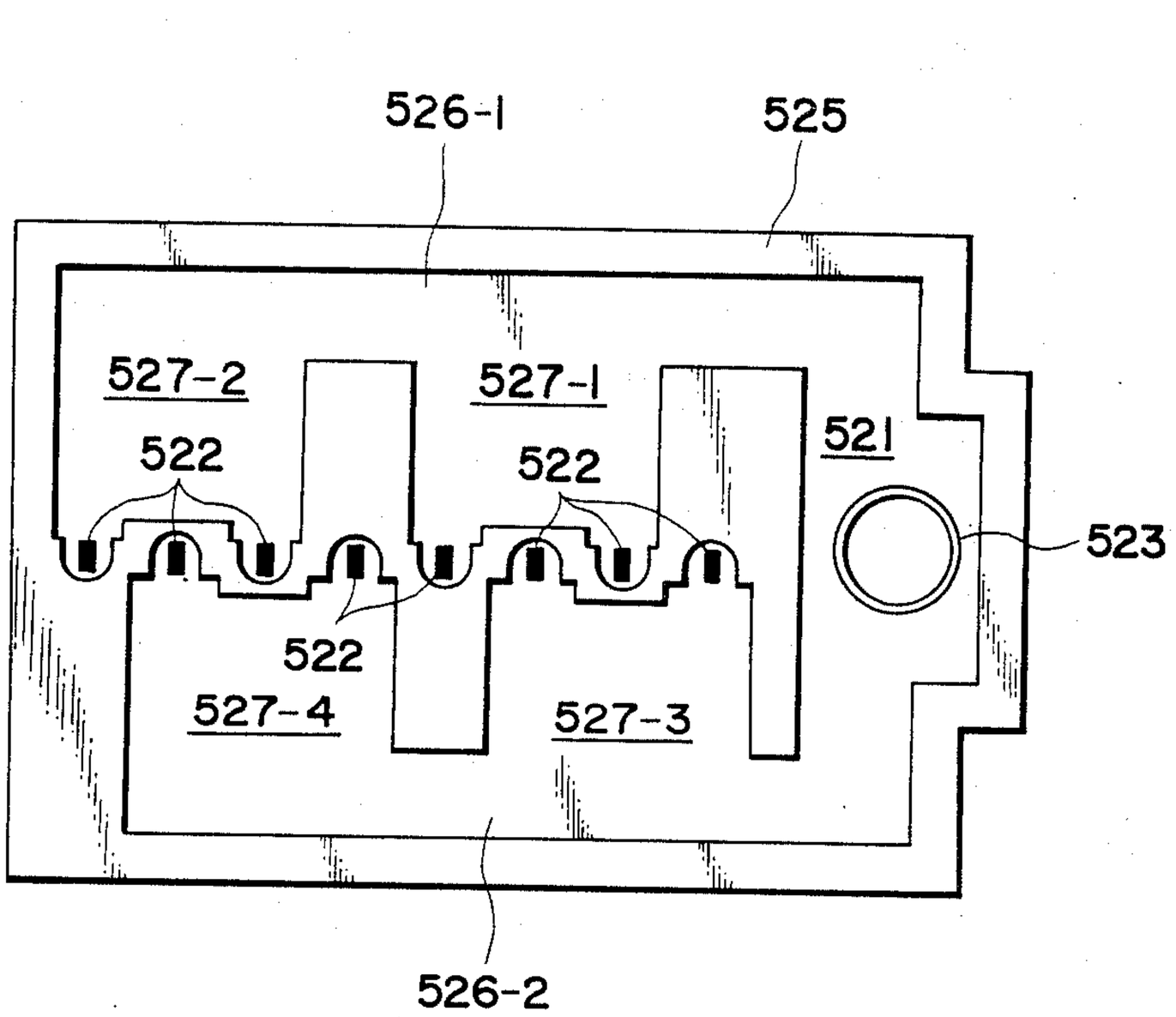

FIG. 5

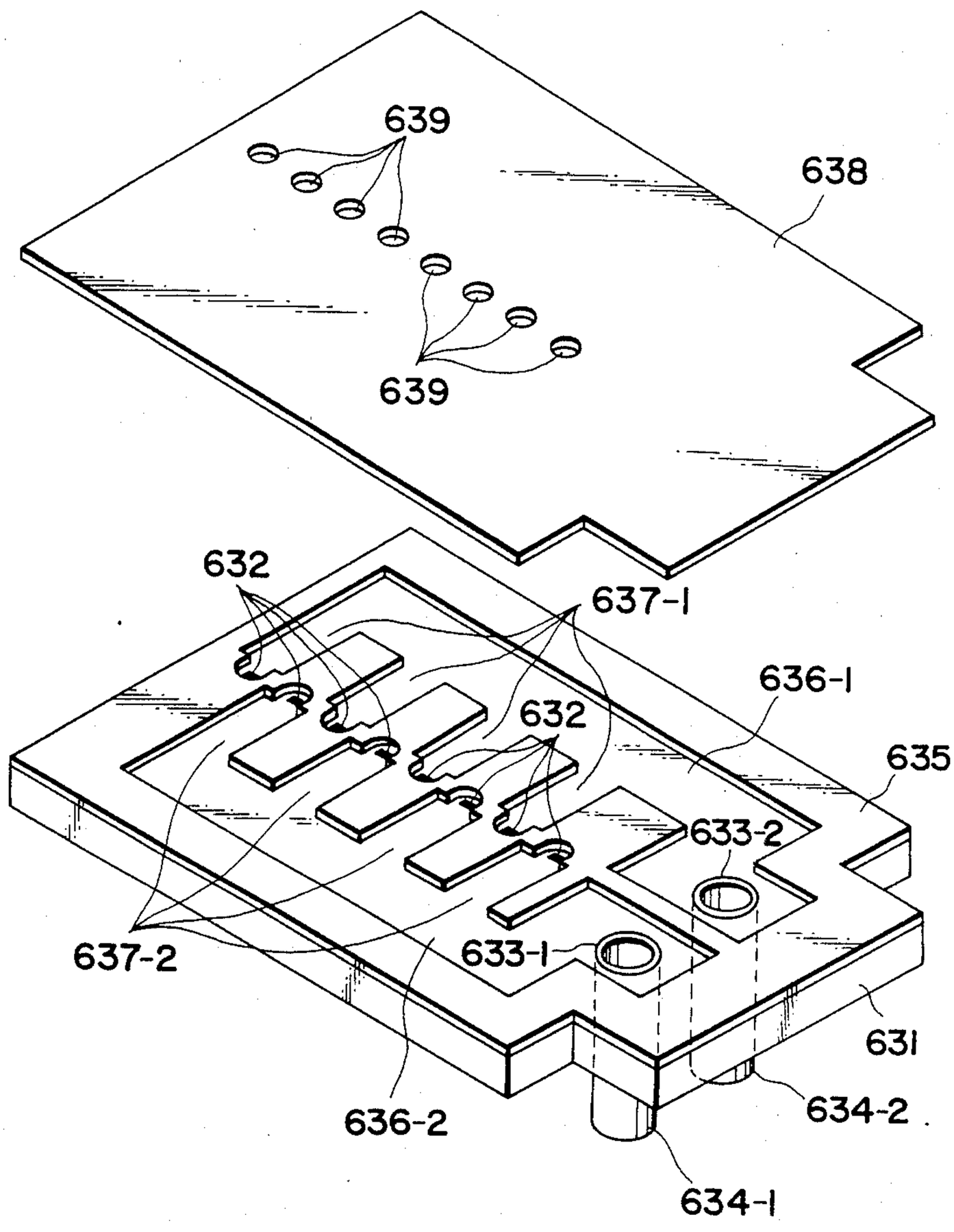
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FIG. 6

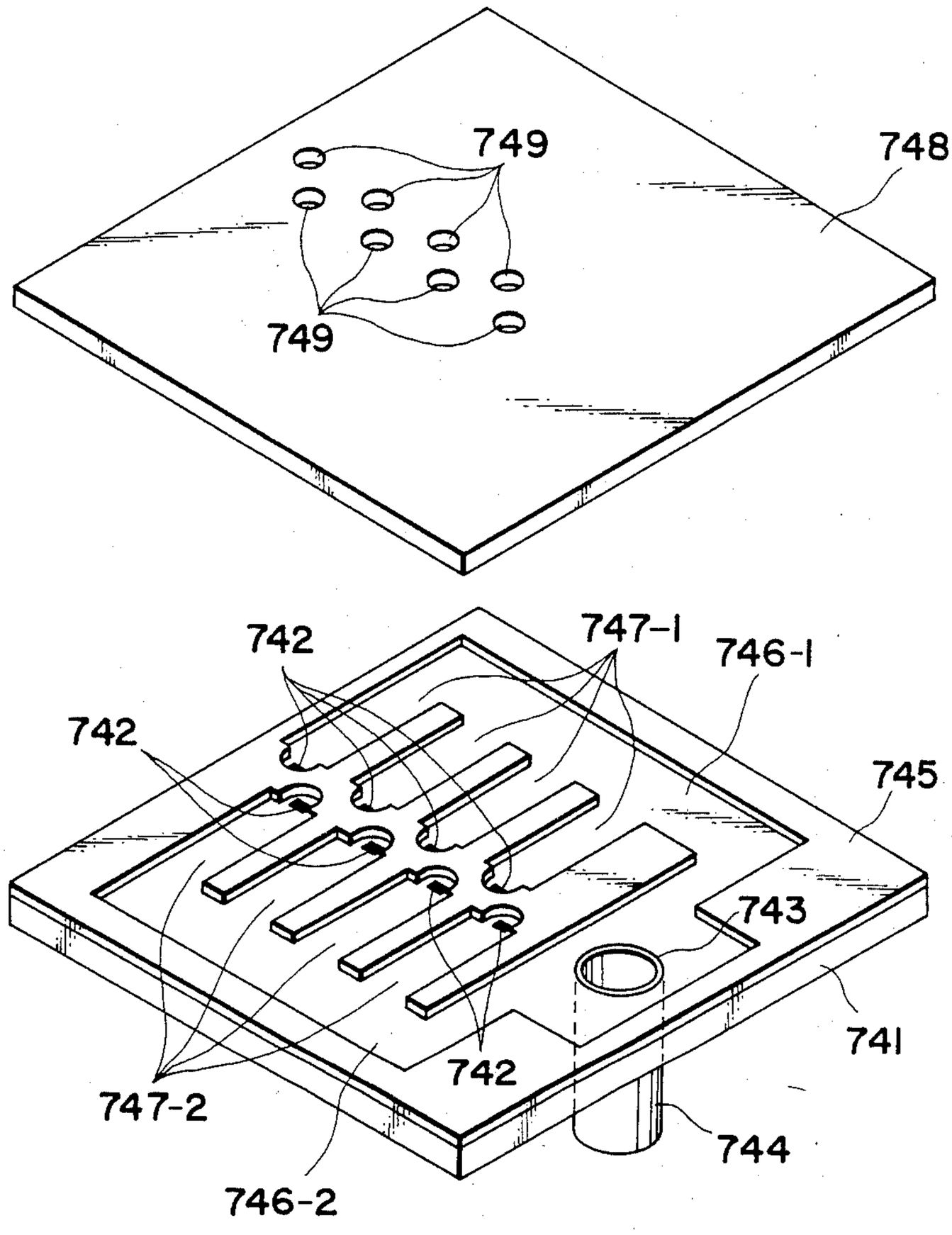

FIG. 7

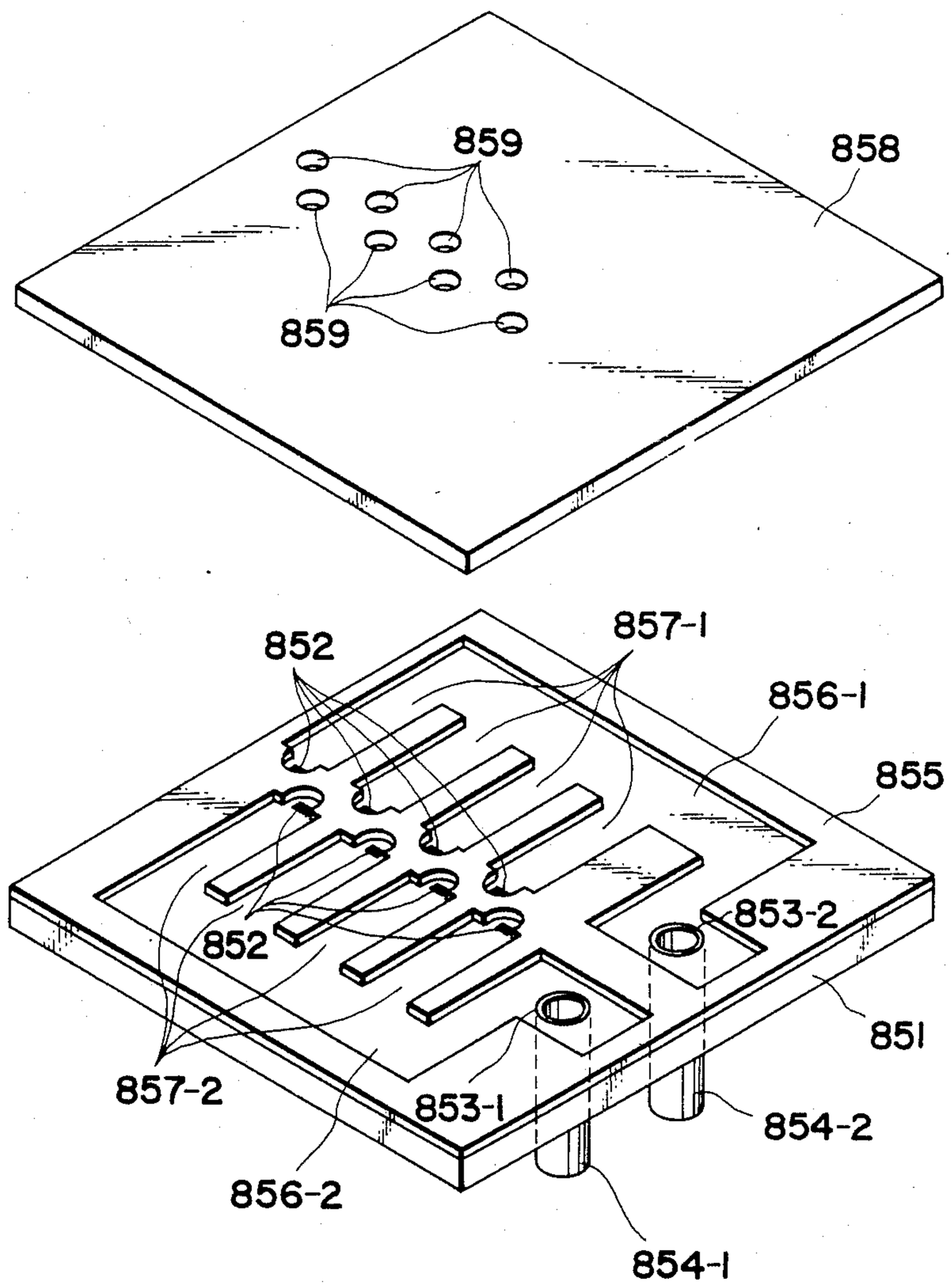
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FIG. 8

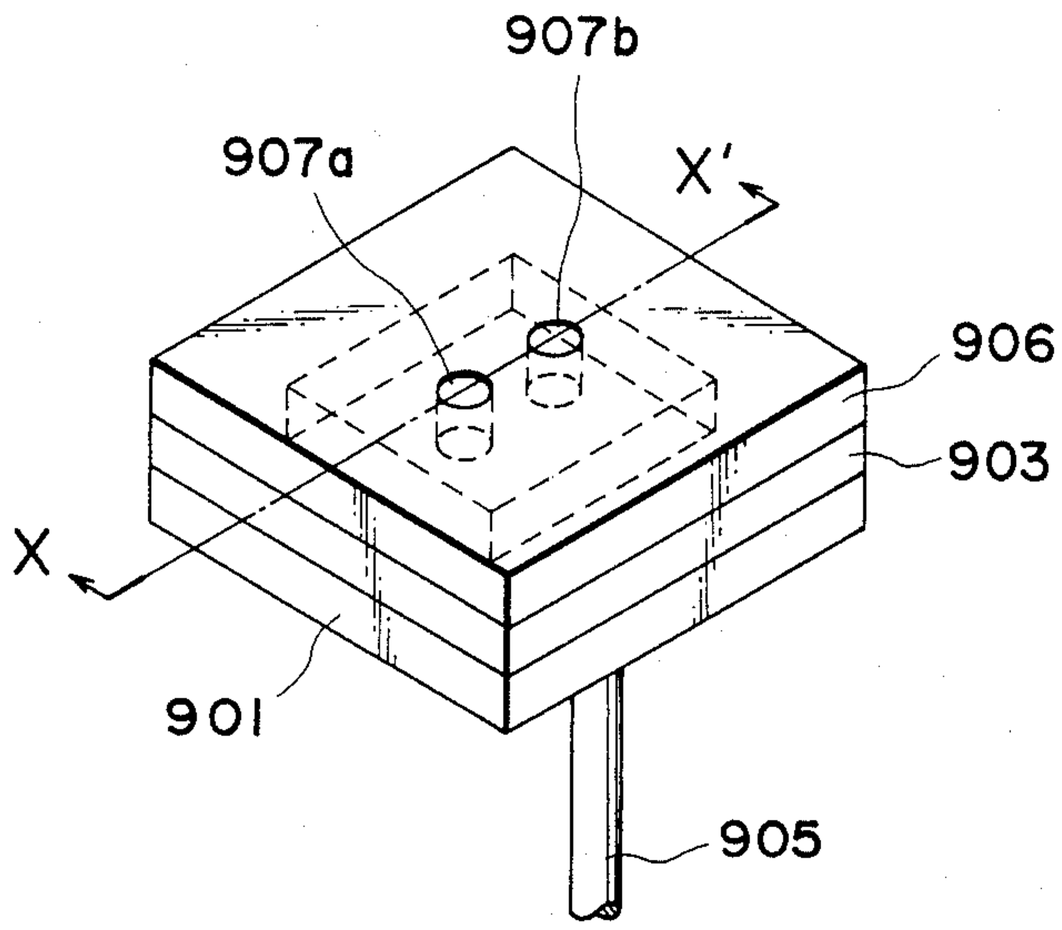

FIG. 9A

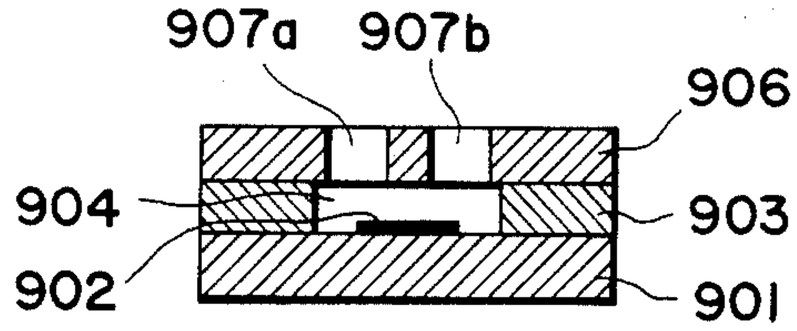

FIG. 9B

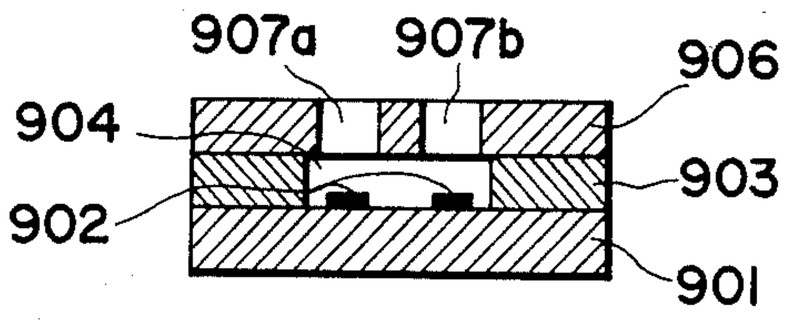

FIG. 9C

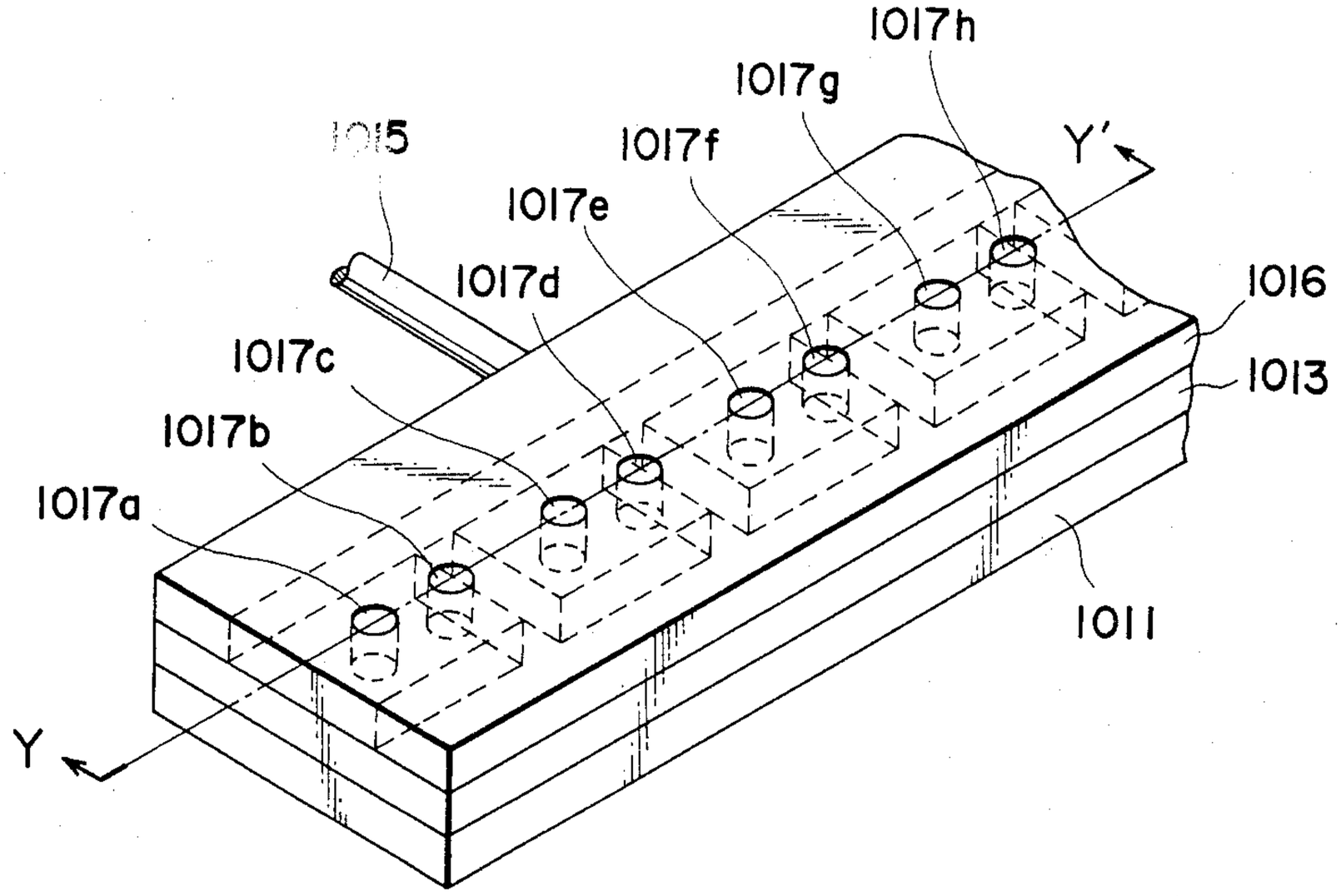

FIG. 10A

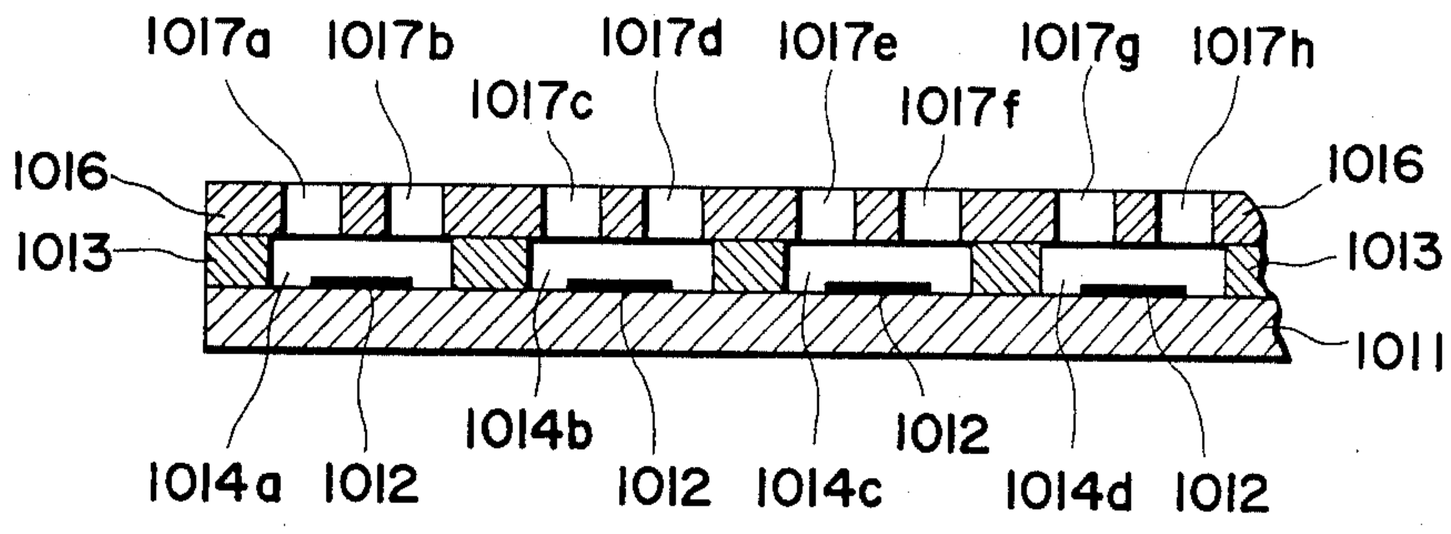

FIG. 10B

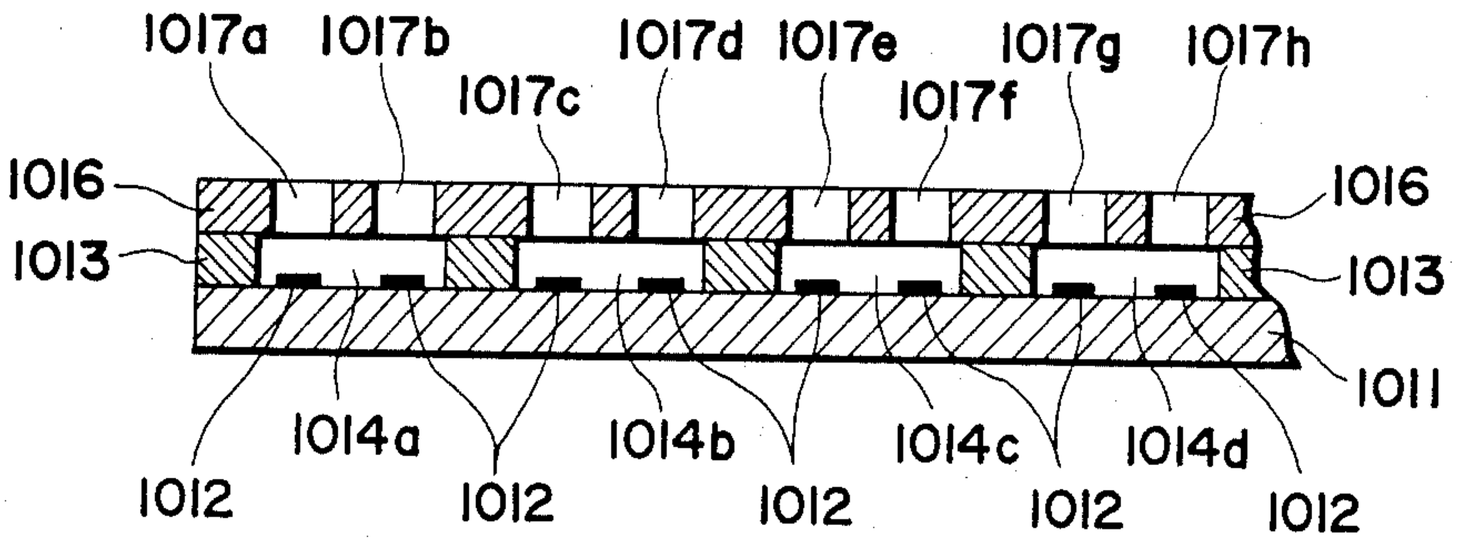

FIG. 10C

LIQUID-JETTING HEAD

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to liquid-jetting heads and more particularly to liquid-jetting heads suited for producing droplets of recording liquid (ink) in ink-jet recording systems.

2. Description of the Prior Art

The ink-jet recording system is a method for recording by ejecting a recording liquid called "ink" through fine nozzles, while transforming the liquid into droplets in various ways (e.g. by application of electrostatic attraction, utilization of oscillation of piezo elements, and so on), and causing the droplets to adhere onto recording paper or the like. Liquid-jetting heads used in this system are generally provided with fine-jetting nozzles (orifices), liquid passages, and liquid-jetting energy generators, such as piezo elements or heating elements, which are set up in the individual liquid-passages and generate the droplet-forming energy to exert on the liquid. As in the fields of other recording systems, research and development has been made in the field of ink-jet recording systems, for the purpose of realizing multicolor or full-color recording in addition to monochromatic recording. Liquid-jetting heads for multicolor or full-color recording need each to have a plurality of separated liquid passages and orifices for each color liquid in order to separately introduce and eject different color inks. Heretofore, however, satisfaction of the above requirements was accompanied by such difficulties that the inner structure of the heads became extremely complicated and reliable heads are hence difficult to obtain and that the heads, becoming large in size, are hardly adaptable in particular for the so-called serial recording, which performs recording with moving heads. Additionally, in order to accomplish high-speed and high-resolution recording, it is necessary for multicolor or full-color ink-jet recording heads each to have plural orifices, liquid passages, and liquid-jetting energy generators (liquid-jetting pressure generators) arranged all in much higher density. The prior art recording heads such multiplied in components and integrated in a high density have drawbacks such as insufficient refilling of ink into the heads, infeasibility to accomplish real high-speed recording, and incapability of attaining high responsiveness to signals.

Another important subject imposed on liquid-jetting heads is to densify ink dots on recording paper for the purpose of improving the quality of letters printed (continuous dots are preferred in quality). However, according to the prior art, it has been very difficult on account of restrictions upon the fabrication technique to obtain such heads that give high-density ink dots.

SUMMARY OF THE INVENTION

The primary object of this invention is to eliminate the foregoing drawbacks of the prior art.

Thus, an object of this invention is to provide a small-sized liquid-jetting head having compacted multi-orifices.

Another object of this invention is to provide a liquid-jetting head highly valuable in practical use having both a high-speed recording function and a high-density recording function.

A further object of this invention is to provide a thin, compact liquid-jetting head capable of giving steadily high-density ink dots.

A still further object of this invention is to provide a liquid-jetting head suited for multicolor or full-color recording.

According to the present invention, there is provided a liquid-jetting head comprising a plurality of liquid-jetting-pressure-generating elements and a plurality of liquid-jetting orifices opposite to said elements through a liquid passage, characterized in that said passage is divided into at least two groups, and the adjacent elements of said elements are separately communicated with isolated respective liquid passages.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of an embodiment of this invention.

FIG. **2** is an external perspective view of the above embodiment.

FIG. **3** is an external perspective view of another embodiment of this invention.

FIGS. **4** and **6–8** are exploded perspective views of other embodiments of this invention.

FIG. **5** is a plan view of the principal portion of another embodiment of this invention.

FIG. **9A** is an external perspective view of other embodiments of this invention.

FIGS. **9B** and **9C** are cross-sectional views taken on line X—X′ of FIG. **9A**.

FIG. **10A** is an external perspective view of embodiments of long sized type of this invention.

FIGS. **10B** and **10C** are cross-sectional views taken on line Y—Y′ of FIG. **10A**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to the drawings, this invention is described in detail.

As shown in FIG. **1**, which is an exploded perspective view of an embodiment of the present liquid-jetting head, a desired number (eight in FIG. **1**) of liquid-jetting-pressure-generating elements **2**, such as heating elements or piezo elements, for generating the liquid-jetting pressure are first disposed on a base plate **1** made of a suitable material selected from glass, ceramics, plastics, silicon, metals, or the like. The jetting-pressure is generated, when said elements **2** are heating elements, by heating their neighboring liquid therewith, and when said elements **2** are piezo elements, by mechanical oscillation thereof. These elements **2** are connected each to an input-signal-applying electrode, which is not depicted. For this purpose the multilayer wiring method can be applied which utilizes a fabrication technique, for example, photolithography or vacuum deposition. The base plate **1** is penetrated with two perforations **3-1** and **3-2**, to which conduits **4-1** and **4-2** are fitted, respectively. In this case, the conduit **4-1** communicates with the first liquid chamber mentioned below.

A plate **5**, which is laid on the upper surface (having the elements **2**) of the base plate **1**, has (1) a perforation **7** communicating with the conduit **4-2**, (2) an opening **6** as the first liquid chamber which communicates at a restricted space thereof with the conduit **4-1** and faces at restricted spaces thereof, the alternate elements **2**, and (3) perforations **8-1** which separately face the alternate elements **2** other than the above. Another plate **11**, which is laid on the upper surface of the plate **5**, has (1)

a perforation **10** communicating with the perforation **7**, (2) perforations **8-2** communicating separately with the individual perforations **8-1**, and (3) perforations **9-1** communicating separately with the above-said spaces of the opening **6** which separately face the alternate elements **2**. Accordingly, the perforations **8-2** and **9-1** are aligned so as to correspond with the elements **2** one by one. A plate **12**, which is laid on the upper surface of the plate **11**, has an opening **13** as the second liquid chamber which is similar in shape to the opening **6** but communicates with the perforations **8-2** and with the conduit **4-2** through perforations **7** and **10**, and perforations **9-2** which separately communicate with the individual perforations **9-1**. A plate **14**, which is the top plate laid on the upper surface of the plate **12**, has perforations **8-3** and **9-3** as liquid-jetting orifices which are aligned so as to correspond with the elements **2** one by one.

The base plate **1** and the plates **5**, **11**, **12**, and **14**, described above, are superposed one over another, adjusted to hold the perforations and openings in position, and joined into a single body with an adhesive, screws, or the like. The plates **5**, **11**, **12**, and **14** can be formed from any material suitably selected from silicon, glass, ceramics, plastics, and metals (desirably anti-corrosive to the liquid). The formation of the perforations and openings can be accomplished by various methods including drilling, molding, punching, etching, a method that photoresist is image-exposed and developed, followed by removing the portions corresponding to the perforations and openings by dissolution. For the base plate **1**, materials of high impact strength are suited when piezo elements are used as the elements **2**, and materials having good heat-resisting and heat-releasing properties are suited when heating elements are used as the elements **2**. Somewhat elastic materials can also be used for the plates **5**, **11**, **12**, and **14**, and the cross sections of the perforations in these plates are not limited to be circular as shown in FIG. **1** but permitted to be, for example, rectangular or elliptic.

Because the thus constructed head of FIG. **1** has the two isolated liquid chambers and the two isolated groups of liquid paths, multicolor ink-jet recording such as dichromatic ink-jet recording can readily be realized by operating the head while introducing separately different-color inks thereto.

In FIG. **2**, which is a perspective view of the head of FIG. **1** after completion of its assembly, the same symbols as in FIG. **1** have the same meaning as explained above.

FIG. **3** shows a perspective view of another completed liquid-jetting head which comprises two parallel-disposed heads having nearly the same structure as the head of FIG. **1**, that is, which has two rows of liquid-jetting orifices. In FIG. **3**, the same symbols as in FIG. **1** have the same meaning as explained above, **20-1** and **20-2** represent conduits for the liquid, and **21-3** and **22-3** represent liquid-jetting orifices. Having four isolated liquid chambers and four isolated groups of liquid passages, the head of FIG. **3** is favorably used for multicolor or full-color recording by introducing separately different-color inks (e.g. yellow, cyan, magenta, and black) into the head. It is also possible, though not illustrated by the drawing, that the head of FIG. **1** is modified to construct three of more isolated liquid chambers in the direction of the thickness of the head (the number of plates used will slightly increase).

As described in detail, the above type of liquid-jetting head is advantageous in the following respects:

1. Since a plurality of isolated liquid chambers (and of isolated groups of liquid passages) are integrated at high density in the head, multicolor or full-color ink-jet recording can be readily performed by introducing each of different-color inks into each isolated liquid chamber (and isolated groups of liquid passage) of the head.

2. Since a plurality of liquid chambers (and of liquid passages) are integrated in the direction of the thickness of the head, the liquid-jetting head can be made thin and compact.

3. Therefore, the liquid-jetting head can be readily adapted for the serial recording system.

FIG. **4** is an exploded perspective view of another embodiment of the present liquid-jetting head. As shown in FIG. **4**, a desired number (eight in FIG. **4**) of liquid-jetting-pressure-generating elements **402** such as heating elements or piezo elements are disposed on a base plate **401** made of a suitable material selected from glass, ceramics, plastics, silicon, metals, or the like. The liquid-jetting pressure is generated, when said elements **402** are heating elements, by heating their neighboring liquid therewith, and when said elements **402** are piezo elements, by mechanical oscillation or displacement thereof. These elements **402** are connected each to an input-signal-applying electrode, which is not depicted. The multilayer wiring method utilizing the vacuum deposition method and the like can be applied to the fabrication for preparing these elements and electrodes.

The base plate **401** is penetrated with a perforation **403**, into which a conduit **404** is fitted. A plate **405**, which is set on the upper surface of the base plate **401**, has an open window of the shape shown in FIG. **4**. The plate **405** can be prepared by hardening a resin composition printed in such a shape on the base plate, which is hardened thereafter; by machine-cutting, molding, or punching, a plate of silicon, glass, ceramic, plastic, or metal; or by a hardened plate resulting from image exposure and development of photosensitive resin (photoresist), followed by dissolution to remove the portion corresponding to the open window. After the plate **405** thus prepared is superposed and positioned on the base plate **401**, the plate **405** is closely fixed to the base plate **401** with an adhesive, screws, or the like.

In this manner, two main liquid passages or chambers **406-1** and **406-2** and their respective branched paths **407-1** and **407-2** are formed on the base plate **401**, said branched paths being all separated one from another by the teeth of comb-like part of the plate **405** which extend alternately in the opposite directions. The innermost parts of the branched paths individually face on the liquid-jetting-pressure-generating elements **402**. Branched paths arranged parallel in such an alternate fashion can be fabricated to have a larger width than those arranged all parallel and adjoining to one another.

A plate **408**, which is called an orifice plate and is on the upper surface of the plate **405**, has liquid-jetting orifices **409** aligned to correspond with the individual elements **402**. This plate **408** can be prepared in the same way from the same material as the plate **405**.

The plates **405**, and **408** are superposed together, adjusted so that the orifices **409** may properly face the elements **402** one by one, and securely fastened together with an adhesive, screws, or the like. The plates **405** and **408** can also be formed in advance into a single body.

Materials used for the base plate **401** and for the plates **405** and **408** are preferably highly corrosion-resistant to the ink used. If a material of poor corrosion resistance

has to be used, it is preferable to subject the material to a corrosion resisting treatment prior to use.

The numbers of the elements **402**, branched paths **407-1** and **407-2**, and liquid-jetting orifices **409** are not particularly limited in this invention although eight is shown as these numbers in FIG. **4**. Also the number of ink conduits to be fitted into the base plate **401** is not limited to one but permitted to be plural. It is also possible by modifying the embodiment of FIG. **4** to connect the main passages **406-1** and **406-2** to each other at a position downstream of the perforation **403**.

The liquid-jetting head thus constructed of FIG. **4**, on actuating desired elements **402** after the ink introduced through the conduit **404** has been filled into the main passages **406-1** and **406-2** and all the branched paths **407-1** and **407-2**, operates to eject the ink through the orifices **409** corresponding to the actuated elements **402**. It is possible in this case to actuate all the elements **402** concurrently or successively or a selected part of the elements **402** individually.

In the next place, an embodiment of modification of the head shown in FIG. **4**, in particular the modification relating to the shape of ink paths, is illustrated with reference to FIG. **5**, which is a plan view of the embodiment of which the orifice plate has been removed. In FIG. **5**, **521** is a base plate and **522** represents ink-jetting-pressure-generating elements, all similar to the ones shown in FIG. **4**; **525**, **523**, and **526-1** and **526-2** correspond to the plate **405**, the perforation **403**, and the main passages **406-1** and **406-2**, respectively, of FIG. **4**. In this embodiment, branched paths **527-1**, **527-2**, **527-3**, and **527-4** wider than those shown in FIG. **4** communicate each with two alternate elements **522** as shown in FIG. **5**. Such a structure of branched paths further improves the efficiency of ink re-filling since the resistance to ink flow through the branched paths is reduced as compared with that in the case of FIG. **4**.

Referring further to FIGS. **6–8**, other embodiments of this invention are illustrated.

In these drawings, when the last figure and the hyphenated figure in the reference numeral agree with the those in FIG. **4**, the former symbol has the same meaning as that of the latter; therefore the meaning will not be explained.

In the embodiment of FIG. **6**, since the liquid passage consisting of a main passage **636-1** and branched paths **637-1** and the liquid passage consisting of a main passage **636-2** and branched paths **637-2** are isolated from each other, dichromatic ink-jet recording can be readily performed by introducing separately two different-color inks through liquid conduits **634-1** and **634-2**.

FIG. **8** illustrates a modification of the head of FIG. **6**, somewhat altered therefrom in that liquid-jetting orifices are disposed alternately on two close parallel lines. Accordingly, with the head of FIG. **8**, dichromatic ink-jet recording can be readily performed as in the case with the head of FIG. **6**. The embodiments of FIGS. **6** and **8** can likewise be modified to have three or more isolated liquid passages (not depicted) with which three- or more-color ink-jet recording can be performed by using three or more different-color inks.

FIG. **7** illustrates a modification of the head of FIG. **4**, somewhat altered therefrom in that ink-jetting orifices are disposed alternately on two close parallel lines. Thus, according to the embodiment of FIG. **7** or **8**, the head length in the direction of the alignment of ink-jetting orifices can be reduced sufficiently. The embodiment of FIG. **7** also can be further modified similarly to the embodiment of FIG. **4** as referred thereto (not depicted).

As described above referring to FIGS. **4–8**, these heads of this invention, in thin plate form, are provided with branched liquid paths of which the width is expandable at least twice as large as that of branched liquid paths arranged all parallel and adjoining to one another. Such expanded widths of branched liquid paths, having much decreased resistance to ink flow, permit a reduction of the time for refilling ink after one shot of ink-jetting and hence realize high-frequency ink jetting. In addition, since the branched liquid paths are divided in two directions (groups), it is possible to decrease the density of branched paths aligned. Therefore, liquid paths having reduced flow resistance can be disposed in lower density as compared with the density of the liquid-jetting orifices.

Thus, a high-speed recording becomes possible from the high-frequency ink-jetting function of these heads, and a high-density recording is achievable on account of the high density alignment of orifices on these heads. In addition, these heads can be constructed in a thin and compact size. Another advantage of these heads is that dichromatic or multicolor ink-jet recording can be easily performed with a single head by dividing branched liquid paths into two or more isolated groups, each of the isolated groups acting as an isolated liquid chamber.

Referring still further to FIGS. **9-A**, **9-B**, and **9-C**, other embodiment of this invention are described.

FIG. **9-A** is an external perspective view of the embodiments and FIGS. **9-B** and **9-C** are cross-sectional views taken on line X—X′ of FIG. **9-A**.

In these drawings, **901** represents a base plate made of a material such as glass, ceramic, plastic, silicon, metal, or the like. A desired number (one in FIG. **9-B** and two in FIG. **9-C**) of liquid-jetting-pressure-generating elements **902** such as heating elements or piezo elements are disposed on the upper surface of the base plate **901**. The jetting-pressure is generated, when the elements **902** are heating elements, by heating the neighboring liquid therewith, and when the elements **902** are piezo elements, by mechanical oscillation or displacement thereof. These elements are connected each to an input-signal-applying electrode, which is not depicted. For the connection, the multilayer wiring method currently prevailing in the semiconductor industry can be utilized which comprises forming desired patterns by photolithography on conductive films of Al, Au, or the like, which together with electric insulating films of SiO_2, Si_3N_4 or polyimide are alternately laminate.

A plate **903** is a spacer made of a similar material as used for the base plate **901** and has an internal open space which serves as a liquid chamber **904**. Ink can be introduced into the liquid chamber **904** through a liquid conduit **905** fitted in a perforation, which is not depicted, penetrating the base plate **901**. The conduit **905** can also be fitted into a portion of the spacer **903**. The number of such conduits is not limited to what is shown in FIG. **9-A**. A plate **906** made of a similar material as used for the base plate **901** is provided with liquid-jetting orifices **907***a* and **907***b*, which are disposed as close to one another as the micro-fabrication technique permits. The number of the orifices also is not limited to what is shown in FIG. **9-A**; three or more, e.g. 3–5, orifices can be densely disposed per one liquid chamber **904**.

Further, the elements **902** can be modified to correspond separately to the individual liquid-jetting orifices,

as shown in FIG. 9-C; that is, the same number of elements **902** as of the orifices can be disposed in the liquid chamber **904**.

When recording paper (not depicted) is scanned with the thus constructed liquid-jetting head in the direction nearly perpendicular to the line X—X′ with its orifice side surface being opposed and kept close to the paper while actuating the elements **902**, droplets of ink are ejected through the orifices **907***a* and **907***b* to form ink dots on the recording paper in the same pitch as that between the orifices **907***a* and **907***b*. In other words, the distance between the ink dots by the orifice **907***a* and by the orifice **907***b* is equal to the distance between the orifices **907***a* and **907***b;* the orifices are so close that the two ink dots overlap each other; accordingly the letters printed look to consist of continuous lines, particularly in the longitudinal direction, unlike the case with the prior art ink-jetting head.

Further embodiments of this invention are illustrated referring to FIG. **10**-A, which is an external perspective view of the embodiment, and to FIGS. **10**-B and **10**-C, which are cross-sectional views taken on line Y—Y′ of FIG. **10**-A.

In these drawings; **1011** corresponds to the base plate **901** of FIG. **9**A; **1012** to the liquid-jetting-pressure-generating elements **902**; **1013** to the spacer **903**; **1014***a*, **1014***b*, **1014***c*, and **1014***d* all to the liquid chamber **904**; **1015** to the conduit **905**; **1016** to the plate **906**; and **1017***a*, **1017***b*, . . . , and **1017***h* all to the liquid-jetting orifices of FIG. **9**.

As in the head of FIG. **9**A, the liquid-jetting orifices **1017***a*, **1017***b*, . . . , and **1017***h* are disposed linearly as shown in FIG. **10**A or in zigzag form, as close to one another as the micro-fabrication technique permits. The number of these orifices is not limited to what is shown in FIG. **10**-A; three or more, e.g. 3–5, orifices can be densely disposed per one liquid chamber.

In addition, the element **1012** can be modified, similarly to the embodiment shown in FIG. **9**-C, so as to correspond separately to the individual liquid-jetting orifices as shown in FIG. **10**-C; that is, the same number of elements **1012** as of the orifices can be disposed in each liquid chamber.

When recording paper (not depicted) is scanned with thus constructed liquid-jetting head in the direction nearly perpendicular to the line Y—Y′ with its orifice side surface being opposed and kept close to the paper while actuating the elements **1012**, droplets of ink are ejected through the orifices **1017***a*, **1017***b*, . . . , **1017***h* to form ink dots on the paper in the same pitch as that between the orifices. The orifices are disposed so closely to each other that adjacent ink dots overlap each other; accordingly the letters printed on the paper look to consist of continuous lines, particularly in the longitudinal direction.

Moreover, when applying such long head as shown in FIG. **10**A having liquid-jetting orifices disposed over the same length as the longitudinal size of the recording paper used, it is possible to complete recording over the whole area of a sheet of paper with one scanning, thus permitting a considerable reduction in recording time as compared with the case where such short heads as shown in FIG. **9**A are applied.

For actuating a plurality of liquid-jetting-pressure-generating elements, either of the operational modes, simultaneous and successive, may be adopted.

As described above, the liquid-jetting heads shown in FIGS. **9** and **10** have the following advantages:

1. These heads give high-quality prints, unobtainable by the prior art, because they forms high-density ink dots, in particular densely arranged in the longitudinal direction.

2. Since the liquid-jetting orifices are disposed very adjacently to the liquid-jetting-pressure-generating elements and in very high density, these heads can be in very thin and compact form.

3. Since it is relatively easy to form finely the liquid-jetting orifices in high density, these heads themselves can be fabricated easily in high yield.

The systems shown in FIGS. **9** and **10** can be applied to the systems as shown in FIGS. **1** and **3** to **8**.

Firstly, the embodiments shown in FIGS. **1** and **3** to **8** can be modified in such a way that a plurality of liquid-jetting orifices correspond to one liquid-jetting-pressure-generating element as shown in FIGS. **9**B and **10**B. For example, in FIG. **1**, each liquid-jetting orifice may be further divided into a plurality of orifices.

Secondly, the embodiments shown in FIGS. **1** and **3–8** can be modified in such a way that a plurality of liquid-jetting-pressure-generating elements correspond to the same number of liquid-jetting orifices as that of the elements in one liquid chamber (i.e., in each branched path) as shown in FIGS. **9**C and **10**C. For example, in FIG. **4**, each liquid-jetting-pressure-generating element may be further divided into a plurality of elements and each liquid-jetting orifice may be divided corresponding to the division of elements.

What we claim is:

1. A recording head, for liquid jet recording apparatus, comprising a generally flat orifice plate with an array of orifices spaced apart in the plane of said orifice plate for the ejection of liquid and a base member on which said orifice plate is mounted; wherein:

said base member includes a plurality of chambers for receiving recording liquid supplied to the head, each said chamber being associated exclusively with a set of said orifices;

each said chamber has a number of separate branch paths associated therewith for receiving recording liquid directly from said chamber and conveying it to said set of orifices associated therewith in a direction generally parallel to the plane of said orifice plate;

each said branch path includes a pressure-generating transducer arranged for applying pressure impulses to liquid in said branch path to eject recording liquid from a corresponding orifice in a direction transverse to the direction of liquid conveyance thereto; and

a wall of at least one of said chambers and said branch paths associated therewith is provided by a surface of said orifice plate.

2. A recording head according to claim **1**; wherein said base member has a layered construction and said chambers and branch paths are formed by spaces in at least one said layer of said base member.

3. A recording head according to claim **2**, having first and second said chambers; wherein said first and second chambers and said branch paths associated therewith are provided at different levels in the direction of the thickness of said base member.

4. A recording head according to claim **3**; wherein:

said first chamber and said branch paths associated therewith are formed by spaces in a first layer of said base member and said second chamber and said branch paths associated therewith are formed

by spaces in a second layer of said base member; and

the upper of said first and second layers is disposed nearer said orifice plate and includes apertures for conveying recording liquid from said branch paths formed by said lower layer to said set of orifices associated with said chamber formed by said lower layer.

5. A recording head according to claim **2**, having first and second said chambers; wherein said first and second chambers and said branch paths associated therewith are formed by spaces in a common layer of said base member.

6. A recording head according to claim **5**; wherein said chambers are arranged for receiving recording liquid from a common supply.

7. A recording head according to claim **1**; wherein each said chamber comprises an elongated space and said branch paths associated with said chambers are spaced along said elongated spaces and extend laterally therefrom.

8. A recording head according to claim **7**, having first and second said sets of orifices arranged in a row; wherein every other said orifice is in the same said set and adjacent said orifices are arranged for ejecting recording liquid from a different said branch path.

9. A recording head according to claim **1**; wherein each said branch path conveys liquid to a single said orifice.

10. A recording head according to claim **1**; wherein each said branch path conveys recording liquid to a plurality of said orifices.

11. A recording head according to claim **1**; wherein one said transducer is provided for each said orifice.

12. A recording head according to claim **1**; wherein each said branch path includes one said transducer for a plurality of said orifices.

13. A recording head according to claim **1**; wherein said base member has a layered construction and includes a support plate carrying a layer of said base member having said chambers and branch paths formed therein and said transducers are mounted on said support plate.

14. A recording head according to claim **13**; wherein said orifices are substantially aligned with corresponding transducers.

15. A recording head according to claim **1**; wherein said chambers are mutually isolated for receiving recording liquid from different sources.

16. Image recording apparatus comprising a recording head, means for supplying recording liquid to said recording head and means for controlling deposition of recording liquid by said recording head on a recording medium, said recording head including a generally flat orifice plate with an array of orifices spaced apart in the plane of said orifice plate for the ejection of liquid and a base member on which said orifice plate is mounted; wherein:

said base member includes a plurality of chambers for receiving recording liquid supplied to the head, each said chamber being associated exclusively with a set of said orifices;

each said chamber has a number of separate branch paths associated therewith for receiving recording liquid directly from said chamber and conveying it to said set of orifices associated therewith in a direction generally parallel to the plane of said orifice plate;

each said branch path includes a pressure-generating transducer arranged for applying pressure impulses to liquid in said branch path to eject recording liquid from a corresponding orifice in a direction transverse to the direction of liquid conveyance thereto; and

a wall of at least one of said chambers and said branch paths associated therewith is provided by a surface of said orifice plate.

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